Using a Rod Drop Monitor to prevent cylinder and piston/rod repair

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Amoco Exploration and Production's Painter NGL/NRU Complex Gas Processing Plant.

Amoco Exploration and Production's Painter NGL/NRU Complex Gas Processing Plant is located 10½ miles northeast of Evanston, Wyoming. Average daily throughput is approximately 7.4 million cubic metres (260 million cubic feet) of natural gas, composed of 800 barrels of condensate, 8,000 to 14,000 barrels (depending on the operating mode) of natural gas liquids, 3.4 million cubic metres (120 million cubic feet) of hydrocarbon gas, and 3.4 million cubic metres (120 million cubic feet) of nitrogen.

Current installation

Painter uses Bently Nevada 3300/80 Six-Channel Rod Drop Monitors on three Heat Pumps and four Residue Gas Compressors, a total of 44 cylinders. The Rod Drop Monitors are all programmed for Average Rod Position. Twice a week, the Mechanical Maintenance department collects Rod Drop Monitor display values from machines on its Processing Reporting Information Data Entry (PRIDE) route. Mechanical Maintenance and Predict Teams then analyze this information.

The Bently Nevada 3300 System Monitor has a Dynamic Data Interface (DDI) Communication Processor option. The racks are connected together and are, in turn, connected via RS-422 to a Dell Pentium II computer running Bently Nevada's Data Manager® 2000 for Windows NT Software. This system provides redundant monitoring and trending of the rod drop monitor data.

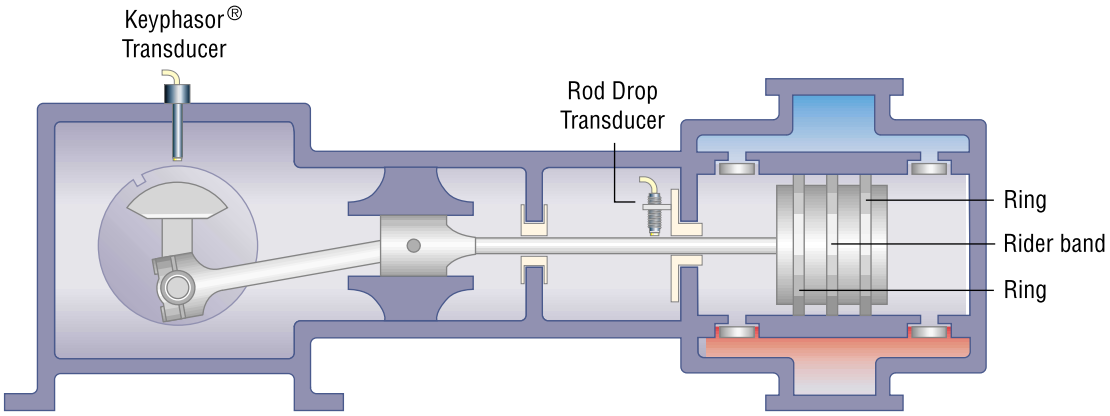

Figure 1. Cross section of Heat Pump Compressor.

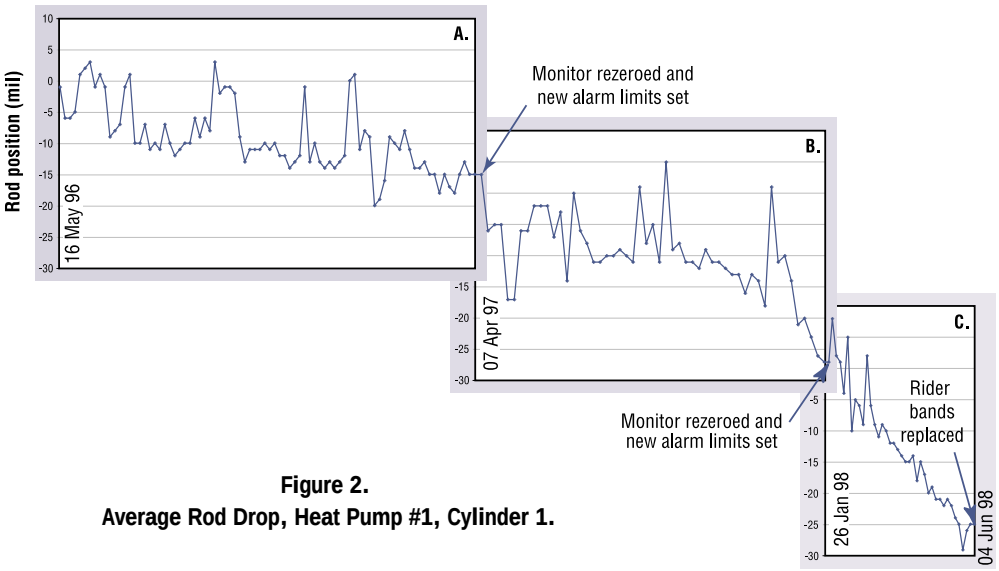

Figure 2.
Average Rod Drop, Heat Pump #1, Cylinder 1.

Avoiding cylinder and piston/rod repair

There have been several instances where use of this data has prevented an expensive cylinder and piston/rod repair, while maximizing the runtime of the piston rider bands. The #1 cylinder on the #1 Heat Pump is one such example. On May 16, 1996, during preventive maintenance of the compressor, the piston-to-cylinder liner clearance was 1.9 mm (0.075 inch). On April 11, 1997 during a partial plant shutdown, the piston-to-liner clearance had decreased to 1.6 mm (0.063 inch). Figure 2A shows a Rod Drop Monitor reading change of approximately 0.31 mm (0.012 inch) during this time period. The monitor channel was "hot zeroed," and new alarm setpoints were entered.

The cylinder #1 channel went into "Alert" alarm in late December 1997. On January 16, 1998, the piston-to-liner clearance was checked through a head end discharge valve port and was 1.40 mm (0.055 inch). Figure 2B shows additional data from the PRIDE route, which indicates a 0.69 mm (0.027 inch) change. A review of the data suggested the discrepancy was probably due to the difficulty of making measurements through the discharge port. The monitor was hot zeroed again and alarm setpoints were entered, based on the new clearance.

The Rod Drop Monitor channel for the #1 cylinder went into "Alert" alarm again in early May 1998. A work order was written for another measurement of piston-to-liner clearance. The compressor was removed from service on June 4, 1998, and the piston-to-liner clearance was again checked through a head end discharge port. This time the clearance was 0.38 mm (0.015 inch). Figure 2C shows a 0.53 mm (0.021 inch) change during this period.

Conclusions

Getting a precise measurement of piston-to-liner clearance through the discharge valve port is difficult under the best of circumstances. Although one of the measurements was radically different, the total change in piston-to-liner clearance between May 16, 1996 and June 4, 1998, 1.52 mm (0.060 inch), agreed with the PRIDE route Rod Drop Monitor readings during this same period. The plots presented a clear trend of wear that could be used to predict wear rates and the effects of modifications to the process, lubrication, etc. Proper installation of the monitor system and confirmation of its operation is very important, though. Confidence in the system must be established before it can be used effectively.

The compressor was out-of-service for eight hours; the total cost of the repair parts, labor, and production loss was $10,600. If the piston had contacted the cylinder liner enough to require liner replacement and piston/piston rod repair, a conservative estimate of the repair cost/production loss would be $54,000.

Postscript: Based on PRIDE data rod drop trend and Data Manager rod drop trend of the #4 cylinder on the #4 Residue Gas Compressor, Painter Operations and Maintenance supervisors were advised on June 29,1998 that the piston-to-liner clearance needed to be checked. Hydrocarbon gas sales nominations were changed to reflect the necessary reduction of inlet gas rates and downtime was scheduled for checking piston-to-liner clearance. Clearance was measured through a head end discharge valve port on July 1. Clearance was found to be within 0.013 mm (0.005 inch) of the recommended minimum. Since the machine was down and cold, and nominations reflected the unit being out of service all day, the piston rings and rider bands were replaced. Painter Operations and Maintenance considered this another save. Cylinder liner, piston, and piston rod repair and unplanned production loss were again avoided.